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Use of airborne LiDAR and hyperspectral data to study the sandy beach morphology along the Lazio region coast (Italy)

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This research address the multisensors methodology in coastal morphology by a combined use of airborne LiDAR (Light Detection and Ranging) and Hyperspectral MIVIS (Multi-spectral IR and Visible Imaging Spectrometer) data to study a beach-dune system. A physics based approach was applied to MIVIS and LiDAR airborne data, simultaneously acquired on 12 May 2009 in order to integrate geomorphological and sedimentological observations into a detailed coastal map of two study areas of the Lazio Region (Central Italy).
The basic strategy was to highlight the different components of the coastal system through:
1) maps of coastal morphology, where the topography and bathymetry DSM were used to produce a) the contour line of the +0.3 m on the mean sea level, to obtain a tide independent shore line, b) the standard deviation, the slope and the bathymetric position index (BPI) to obtain an optimal description of the bedforms of the very shallow waters;
2) the combined use of standard deviation maps and endmembers fraction maps, obtained by means of the Spectral Mixture Analysis (SMA) of hyperspectral data, to discriminate different types of bottoms (sands, bedrock and seagrass).
A field campaign was carried out during the airborne survey and a collection of sediment samples has been achieved both in emerged and submerged facies. Field observations allowed identification of sediments properties associated to radiometric features. In particular the presence of significant negative correlations between specific ranges of grain size and specific MIVIS bands leads to the results that spectral responses are linked to the mineralogical composition.
The MIVIS derived endmembers fraction maps were merged to LiDAR derived topo-bathymetric maps in order to classify the facies distribution within the sandy beach-dune systems.
The results shows that the combination of both data types, hyperspectral and LiDAR, provides a very innovative and powerful tool suited to monitor complexity of coastal areas due to coexistence of beach-dune systems, blow outs, gullies, seagrass meadows and sedimentary structures that for the first time in Italy have been investigated with such detail in shallow water system.